

TECHNICAL REPORT BRL-TR-3155

BRL

AD-A230 157

SOLDIER PERFORMANCE OF MILITARY OPERATIONAL
TASKS CONDUCTED WHILE WEARING CHEMICAL
INDIVIDUAL PROTECTIVE EQUIPMENT (IPE):
DATA ANALYSIS IN SUPPORT OF THE REVISION OF THE
U.S. ARMY FIELD MANUAL ON NBC PROTECTION (FM 3-4)

EDWARD G. DAVIS
CHARLES H. WICK
LUCIA SALVI
HOWARD M. KASH

DECEMBER 1990

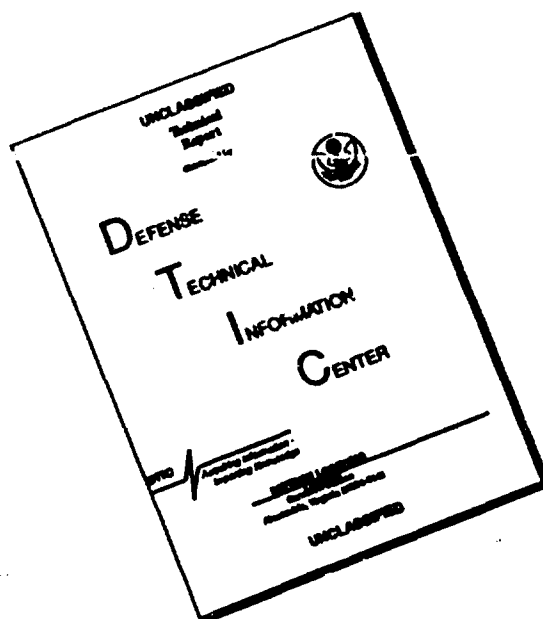
DTIC
ELECTE
DEC 27 1990
S B D

APPROVED FOR PUBLIC RELEASE; DISTRIBUTION UNLIMITED.

U.S. ARMY LABORATORY COMMAND

BALLISTIC RESEARCH LABORATORY
ABERDEEN PROVING GROUND, MARYLAND

DISCLAIMER NOTICE



**THIS DOCUMENT IS BEST
QUALITY AVAILABLE. THE COPY
FURNISHED TO DTIC CONTAINED
A SIGNIFICANT NUMBER OF
PAGES WHICH DO NOT
REPRODUCE LEGIBLY.**

NOTICES

Destroy this report when it is no longer needed. DO NOT return it to the originator.

Additional copies of this report may be obtained from the National Technical Information Service, U.S. Department of Commerce, 5285 Port Royal Road, Springfield, VA 22161.

The findings of this report are not to be construed as an official Department of the Army position, unless so designated by other authorized documents.

The use of trade names or manufacturers' names in this report does not constitute indorsement of any commercial product.

UNCLASSIFIED**REPORT DOCUMENTATION PAGE**Form Approved
OMB No 0704-0188

Public reporting burden for this report is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, DC 20503.

1. AGENCY USE ONLY (Leave blank)		2. REPORT DATE December 1990		3. REPORT TYPE AND DATES COVERED Final, Oct 88 - Jun 90	
4. TITLE AND SUBTITLE Soldier Performance Of Military Operational Tasks Conducted While Wearing Chemical Individual Protective Equipment (IPE): Data Analysis In Support of the Revision of the U.S. Army Field Manual on NBC Protection (FM 3-4)				5. FUNDING NUMBERS 1L162618AH80	
6. AUTHOR(S) Edward G. Davis, Charles H. Wick, Lucia Salvi, and Howard M. Kash					
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)				8. PERFORMING ORGANIZATION REPORT NUMBER	
9. SPONSORING MONITORING AGENCY NAME(S) AND ADDRESS(ES) Ballistic Research Laboratory ATTN: SLCBR-DD-T Aberdeen Proving Ground, MD 21005-5066				10. SPONSORING MONITORING AGENCY REPORT NUMBER BRL-TR-3155	
11. SUPPLEMENTARY NOTES					
12a. DISTRIBUTION AVAILABILITY STATEMENT Approved for public release; distribution is unlimited				12b. DISTRIBUTION CODE	
13. ABSTRACT (Maximum 200 words) The BRL was contracted by the U.S. Army Chemical School (USACMLS) to identify, review, and conduct exploratory data analysis of newly-acquired data related to soldier performance of military operational tasks while wearing chemical IPE. This BRL work was conducted in support of the revision of "Appendix A" entitled "Performance Degradation Data in a Chemical Warfare Environment" of the U.S. Army Field Manual on NBC Protection (FM 3-4). This report describes a) the U.S. Army P2NBC2 Database, b) a computer program that interfaces with the Database, and c) data analysis of selected data fields contained in the Database. Analysis included investigation of the Performance Decrement Factor (PDF), Human Ability Code, Human Sub-Ability Code, and Action Verb Code P2NBC2 Database data fields. A classification scheme formulated from the PDF distribution is presented for evaluation of the 756 military tasks represented in the Database. Ninety percent of all tasks represented in the Database are in PDF Zones A and B. PDF Zone A tasks are classified as "not degraded". PDF Zone B tasks are classified as "slightly degraded" and have an average PDF value of 1.5. The incorporation of this information into a revised FM 3-4 contributes to an enhanced readiness U.S. Army posture for the successful performance of military operations on the chemically contaminated battlefield.					
14. SUBJECT TERMS Performance Degradation, Exploratory Data Analysis, Individual Protective Equipment (IPE), Personnel Modeling				15. NUMBER OF PAGES 32	
16. PRICE CODE				17. SECURITY CLASSIFICATION OF REPORT UNCLASSIFIED	
18. SECURITY CLASSIFICATION OF THIS PAGE UNCLASSIFIED		19. SECURITY CLASSIFICATION OF ABSTRACT UNCLASSIFIED		20. LIMITATION OF ABSTRACT SAR	

UNCLASSIFIED

INTENTIONALLY LEFT BLANK.

TABLE OF CONTENTS

1.0 INTRODUCTION	1
2.0 U.S. ARMY P2NBC2 DATABASE	1
2.1 Introduction	1
2.2 General Description Of The U.S. Army P2NBC2 Database Structure	2
2.3 U.S. Army P2NBC2 Database - Computer Hardware/Software Requirements	2
3.0 A DATABASE AND MODELING COMPUTER PROGRAM	3
3.1. Capability To Access A Subset Of The U.S. Army P2NBC2 Database	3
3.2. Database And Modeling Computer Program - Hardware/Software Requirements	3
4.0 EXPLORATORY DATA ANALYSIS OF DATA CONTAINED IN THE U.S. ARMY P2NBC2 DATABASE	3
4.1 Introduction	3
4.2 The Performance Decrement Factor (PDF)	4
4.3 Analysis Of Selected Data Fields For Tasks Contained In The U.S. Army P2NBC2 Database	4
5.0 SUMMARY	7
6.0 REFERENCES	9
APPENDIX A: LIST OF HUMAN ABILITY CODES AND HUMAN SUB-ABILITY CODES WITH DEFINITIONS	11
APPENDIX B: LIST OF ACTION VERB CODES	17
APPENDIX C: PERCENTAGE DISTRIBUTION FOR PERFORMANCE DECREMENT FACTOR (PDF) ZONES A, B, AND C, FOR HUMAN ABILITY, HUMAN SUB-ABILITY, AND ACTION VERB CODES	21
DISTRIBUTION LIST	27

INTENTIONALLY LEFT BLANK.

LIST OF FIGURES

- 1 Distribution of the Performance Decrement Factor (PDF)
 for all 756 tasks represented in the U.S. Army P2NBC2
 Database, illustrated as a function of number of
 tasks and calculated PDF value 5

- 2 Military task classification scheme illustrating PDF
 Zones A, B, and C. The PDF Zone scheme is based on
 the distribution of the PDF value for all 756 tasks
 represented in the U.S. Army P2NBC2 Database 6

Accession For	
NTIS GRA&I	<input checked="" type="checkbox"/>
DTIC TAB	<input type="checkbox"/>
Unannounced	<input type="checkbox"/>
Justification	
By _____	
Distribution/	
Availability Codes	
Dist	Avail and/or Special
A-1	



INTENTIONALLY LEFT BLANK.

11-11-11

ACKNOWLEDGMENT

The authors wish to express their thanks to LTC Gary Stratton and Mr. Donald Cunningham of the U.S. Army Chemical School, Ft. McClellan, Alabama. Also, the authors wish to thank the following individuals for reviewing the manuscript: Dr. Michael W. Starks, Mr. David N. Neades, Ms. Stephanie S. Juarascio, and Mr. Gerald E. Mion of the U.S. Army Ballistic Research Laboratory, Aberdeen Proving Ground, Maryland.

INTENTIONALLY LEFT BLANK.

1.0 INTRODUCTION

Military operations on a chemically contaminated battlefield present special considerations for the vulnerability analyst and military commander. Primary among these considerations is soldier performance degradation resulting from physical and physiological factors induced by wearing chemical Individual Protective Equipment (IPE).

The U.S. Army Ballistic Research Laboratory (BRL) was contracted by the U.S. Army Chemical School (USACMLS) to identify, review, and conduct exploratory data analysis of newly-acquired data related to soldier performance of military operational tasks conducted while wearing IPE [1]. This BRL effort was conducted in support of the revision of the U.S. Army Field Manual on NBC Protection (FM 3-4) [2]. BRL's input will contribute to a successful update of "Appendix A" of FM 3-4 entitled "Performance-Degradation Data in a Chemical Warfare Environment".

Recently published field test exercise data provide the U.S. Army with soldier performance data for many military operational tasks conducted while wearing chemical IPE, specifically, Mission Oriented Protective Posture Level IV (MOPPIV) [3-18]. The U.S. Army Physiological and Psychological Effects of the Nuclear, Biological, and Chemical Environment and Sustained Operations on Systems in Combat (P2NBC2) Database establishes a U.S. Army corporate knowledge base for the empirical field test data on soldier performance of military operational tasks conducted while wearing IPE [19]. Also, a database and modeling computer program (also referred to as "computer program") was developed to interface with the U.S. Army P2NBC2 Database (also referred to as "Database") [20]. This computer program provides the analyst with a *convenient means to access a subset of the data contained in the Database and to conduct exploratory data analysis.*

The purpose of this report is to describe a) the U.S. Army P2NBC2 Database, b) a computer program designed to interface with the Database, and c) exploratory data analysis of selected data fields contained within the Database. The data analysis provides important information in support of the revision of FM 3-4.

2.0 U.S. ARMY P2NBC2 DATABASE

2.1 Introduction

The P2NBC2 program was established to determine operational limits of performance [21]. The U.S. Army Chemical School is executive agent for the program. BRL has been a focal point in the development of the U.S. Army P2NBC2 Database [22]. This Database drives the direction of future testing and modeling efforts for the P2NBC2 program by (a) establishing a U.S. Army corporate knowledge base for empirical field test data of soldier performance of military operational tasks conducted while wearing chemical protective equipment, and (b) aiding in the identification of data gaps in soldier performance decrement data [19].

2.2 General Description Of The U.S. Army P2NBC2 Database Structure

The Database is an organized collection of information representing 756 military tasks studied in military operational field tests. Military tasks were performed under various field test conditions by (1) various size groups of soldiers wearing standard Battle Dress Uniform [BDU] (equivalent to MOPP0) and (2) various size groups of soldiers wearing MOPPIV chemical IPE.

Each task is represented in the Database as a database record. A Database record consists of 79 data fields for potential information storage. The design of the Database structure can be conceptually viewed as a 756 X 79 data/information matrix.

It should be noted that not all of the data fields are populated with data for the military operational tasks represented in the Database. The 79 data fields were created to store data and information on military operational tasks acquired from a plethora of field test studies. These field test studies have different experimental designs, goals, and objectives governing data acquisition.

The data fields are characterized into the following six subject areas: 1) mission 2) performance 3) biomedical/physiological 4) training 5) environment, and 6) leadership. In addition, the data fields have been characterized into four data types, including raw and processed numerical data and raw and processed coded data [20].

Data field values include, but are not limited to, the a) Performance Decrement Factor (PDF), b) Human Ability Code, c) Human Sub-Ability Code, and d) Action Verb Code. The PDF is defined as the numerical value which when multiplied by the elapsed time for a soldier to perform a military operational task while wearing BDU, results in a numerical value equal to the average elapsed time required to complete the identical military operational task while in MOPPIV. Most military operational tasks represented in the Database as a database record were assigned one Human Ability Code and several Human Sub-Ability Codes on the basis of "best description" of the task. A standardized definition list of the 10 Human Ability Codes and the 42 Human Sub-Ability Codes was established. A listing of Human Ability Codes subdivided into their respective Human Sub-Ability Codes with corresponding definitions is presented in Appendix A. In addition, an Action Verb Code was developed for standardizing the task description. Military operational tasks represented in the Database were assigned an Action Verb Code. A list of Action Verb Codes is provided in Appendix B.

2.3 U.S. Army P2NBC2 Database - Computer Hardware/Software Requirements

The Database is accessible utilizing the database management system dBASE III PLUS [Copyright 1985, 1986, Ashton-Tate, as an unpublished work.] and is implemented on an IBM [IBM is a registered trade mark of International Business Machines, Inc.] or an IBM-compatible personal computer system.

3.0 A DATABASE AND MODELING COMPUTER PROGRAM

3.1 Capability To Access A Subset of The U.S. Army P2NBC2 Database

A computer program was developed at BRL to interface with the U.S. Army P2NBC2 Database [20]. The computer program permits the user to access a subset of the data contained in the Database. The computer program provides a convenient method to access a subset of the Database without requiring user knowledge and skills of the database management system.

The computer program permits data search, retrieval, and calculation of the PDF for a military operational task associated with a) Human Ability Code, b) Human Sub-Ability Code, and c) Action Verb Code. This capability enables an analyst to estimate a PDF for an operational task not investigated in a field test. Estimating a PDF for a military task involves selection of a combination of Human Ability, Human Sub-Ability, and Action Verb Codes to describe the task. An estimated PDF for the task can then be calculated from data contained in the Database.

3.2 Database And Modeling Computer Program - Hardware/Software Requirements

The computer program was developed within the framework of the database management system dBASE III PLUS ® and was compiled to run on an IBM ® or an IBM-compatible personal computer system.

4.0 EXPLORATORY DATA ANALYSIS OF DATA CONTAINED IN THE U.S. ARMY P2NBC2 DATABASE

4.1 Introduction

Numerous BRL reports analyze empirical field data acquired from tests on soldier performance of military operational tasks conducted while wearing chemical IPE [3-11]. This report augments previous BRL reports by presenting data analysis of the PDF data contained in the Database.

BRL vulnerability analysts presently utilize PDF data when conducting modeling and analysis of soldier performance of military operational tasks conducted while wearing chemical IPE. For example, the Army Unit Resiliency Analysis (AURA) Methodology is an event sequenced, one-sided combat simulation methodology developed and maintained at BRL [23,24]. AURA is utilized by an increasing number of analysts in the United States and abroad for unit level survivability/sustainability studies [25]. PDF data have been incorporated into recent BRL AURA studies to characterize soldier performance degradation due to the wearing of MOPPIV [26]. AURA defines a MOPP degradation factor in terms of a soldier "effectiveness rate" to complete a task. This military task "effectiveness rate" can be calculated by computing the mathematical inverse of the PDF (i.e. $1/\text{PDF}$).

4.2 The Performance Decrement Factor (PDF)

The PDF, as previously defined, is a numerical value which when multiplied by the average elapsed time for a soldier to perform an operational task in BDU is equal to the average elapsed time for a soldier to perform the identical task while wearing MOPPIV. The PDF is one of a limited number of the 79 data fields populated with data for all 756 database records contained in the Database.

Published results of U.S. Army empirical field test data analysis provide calculated PDF values for soldiers performing tasks in MOPPIV chemical IPE [3-11]. PDF values were also calculated from published U.S. Air Force Data [12-18]. The Database incorporates the PDF values for both the U.S. Army and the U.S. Air Force military operational tasks.

4.3 Analysis Of Selected Data Fields For Tasks Contained In The U.S. Army P2NBC2 Database

The PDF distribution was plotted as a function of number of tasks and PDF value for all military tasks represented in the Database and is illustrated in Figure 1.

The plot of the PDF distribution can be described as a bimodal distribution having modal values at approximately 1.0 and 1.5 on the x-axis. In fact, the results of the plot suggest that the PDF has a generally Gaussian shape having an approximate mean PDF value within the range of 1.2 to 1.5. The observed bimodal distribution reflects the data acquired from the specific military operational tasks investigated and not the complete spectrum of military tasks that exist. Data acquired in future field test studies of military tasks will provide additional information on the characterization of the PDF distribution.

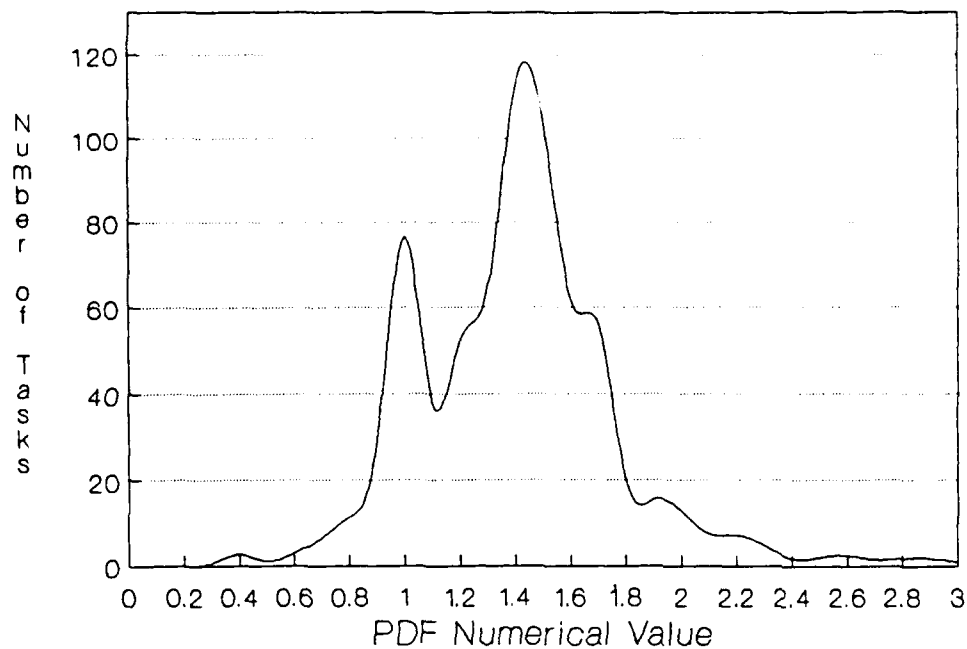


Figure 1. Distribution of the Performance Decrement Factor (PDF) for all 756 tasks represented in the U.S. Army P2NBC2 Database, illustrated as a function of number of tasks and calculated PDF value.

In an attempt to differentiate and classify tasks represented in the Database as not degraded, degraded "slightly", and degraded "moderately", a classification scheme was developed. The classification scheme is based on the statistical distribution of the PDF data as a function of the number of tasks and the PDF value. This scheme classifies all Database tasks into three categories defined as PDF Zones A, B, and C based on the PDF value. The PDF Zone scheme is illustrated in Figure 2.

PDF Zone A contains 21% of the Database tasks and represents tasks which have an average PDF value of 1.0 (PDF range is 0 to 1.15). These tasks are classified as "not degraded". PDF Zone B contains 69% of the Database tasks and represents tasks which have an average PDF value of 1.5 (PDF range is 1.16 to 1.85). PDF Zone C contains 10% of the Database tasks. Tasks in PDF Zone C have PDF values of 1.86 or greater. Tasks with PDF values in PDF Zones B and C are classified as "slightly degraded" and "moderately degraded", respectively.

The PDF Zone scheme is of interest for several reasons. First, military tasks can be classified and evaluated by PDF Zone. Second, similar military tasks are generally classified within the same PDF Zone, and, therefore, are evaluated as being degraded similarly. Third, it provides a scheme for classification and evaluation of data fields such as Human Ability Code, Human Sub-Ability Code, and Action Verb Code.

Database Human Ability, Human Sub-Ability, and Action Verb Code percentage distributions for PDF Zones A, B, and C were calculated and are reported in Table C1, Table C2, and Table C3, respectively, of Appendix C. Human Ability Codes and their corresponding PDF distributions, shown in parentheses, for the three PDF Zones are discussed below. The Human Ability Code with its greater distribution percentage in PDF Zone A, than in PDF Zones B and C, is Precision Control (52%). That is, 52% of the tasks assigned with the Code Precision Control are represented in PDF Zone A.

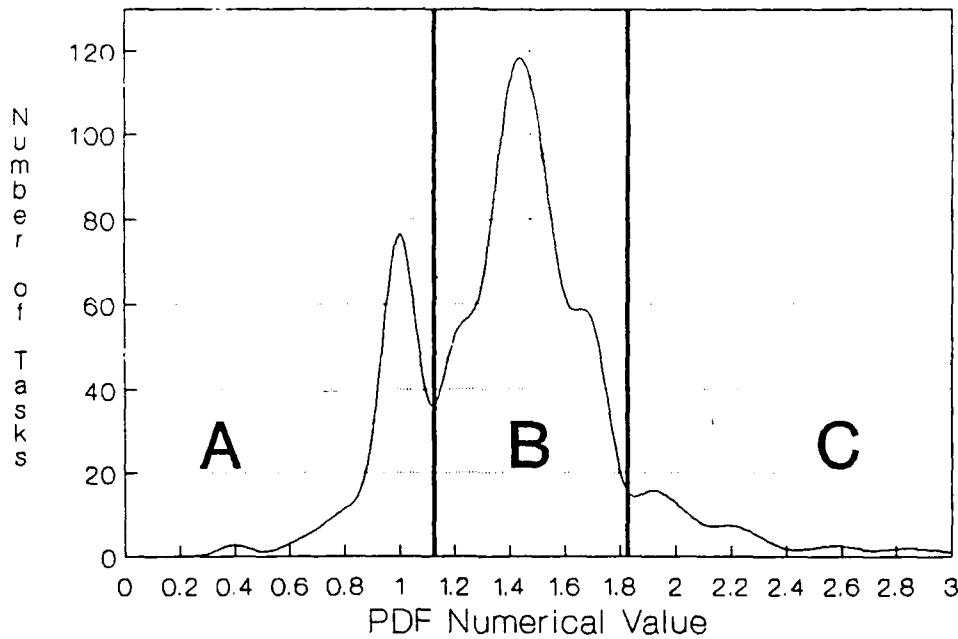


Figure 2. Military task classification scheme illustrating PDF Zones A, B, and C. The PDF Zone scheme is based on the distribution of the PDF value for all 756 tasks represented in the U.S. Army P2NBC2 Database.

The Human Ability Codes which have their highest distribution percentage in PDF Zone B are: *Strength and Stamina* (100%), *Vision* (100%), *Attention and Quickness* (96%), *Communication* (96%), *Visual Pattern* (91%), *Movement and Coordination* (80%), *Decision Making* (67%), and *Manual Control* (56%).

No Human Ability Code has its highest distribution percentage in PDF Zone C. However, *Decision Making* (22%) and *Precision Control* (19%) Human Ability Codes have the highest percentage distribution within PDF Zone C.

The PDF provides a unit of measure that can be utilized as a standard metric for modeling and comparing soldier performance estimates for military operational tasks conducted while wearing MOPPIV. Most importantly, the results indicate that although wearing MOPPIV contributes to performance degradation, it is not an insurmountable obstacle in performing operational tasks. In fact, 90% of all tasks represented in the Database are in PDF Zones A and B, and are classified as "not degraded" or "slightly degraded", respectively. All tasks in PDF Zones A and B have a PDF of 1.85 or less. The remaining 10% of the tasks investigated are in PDF Zone C and have a PDF value of 1.86 or greater.

5.0 SUMMARY

The BRL was contracted by the U.S. Army Chemical School (USACMLS) to identify, review, and conduct exploratory data analysis of newly-acquired data related to soldier performance of military operational tasks while wearing IPE. This BRL work was conducted in support of the revision of "Appendix A" entitled "Performance Degradation Data in a Chemical Warfare Environment" of the U.S. Army Field Manual on NBC Protection (FM 3-4). This report describes a) the U.S. Army P2NBC2 Database, b) a computer program that interfaces with the Database, and c) data analysis of selected data fields contained in the Database.

Analysis included investigation of the Performance Decrement Factor (PDF), Human Ability Code, Human Sub-Ability Code, and Action Verb Code data fields in the Database. The statistical distribution of the PDF as a function of number of tasks and the PDF value was evaluated for all 756 tasks represented in the Database. A classification scheme formulated from the PDF distribution is presented for evaluation of these military operational tasks. The PDF Zone scheme provides a method for estimating a PDF value for a military task that was not investigated in a field test study. Most importantly, the results indicate that although wearing MOPP4 contributes to performance degradation, it is not an insurmountable obstacle in performing operational tasks. In fact, 90% of all tasks represented in the Database are in PDF Zones A and B. PDF Zone A tasks are classified as "not degraded". PDF Zone B tasks are classified as "slightly degraded" and have an average PDF value of 1.5.

Analysis of newly-acquired field test data has increased the U.S. Army's knowledge base concerning soldier performance of military operational tasks conducted while wearing chemical IPE. Analysis of data acquired in field test investigations and incorporated into a revised FM 3-4 contributes to an enhanced readiness U.S. Army posture for the successful performance of military operations on the chemically contaminated battlefield.

INTENTIONALLY LEFT BLANK.

6.0 REFERENCES

1. LTC G. Stratton, U.S. Army Chemical School, FT. McClellan, AL, Contract Officer's Representative (COR), 1989-90.
2. *U.S. Army Field Manual on NBC Protection (FM 3-4)*, Headquarters, Department of the Army, Washington, D.C., 21 October 1985.
3. Morrissey, J. and Wick, C., *Armor Operations In Mission Oriented Protective Posture Level IV (MOPPIV)*, U.S. Army Ballistic Research Laboratory, Aberdeen Proving Ground (APG), MD, BRL-TR-2990, April, 1989.
4. Morrissey, J. and Wick, C., *Degradation of Hawk Air Defense Units Operating in a Hot/Humid Chemical Environment*, U.S. Army Ballistic Research Laboratory, APG, MD, BRL-TR-3053, 1989.
5. Morrissey, J. and Wick, C., *Degradation of Hawk Assault Fire Unit (AFU) Operating in a Chemical Environment*, U.S. Army Ballistic Research Laboratory, APG, MD, BRL-TR-3057, 1989.
6. Wick, C. and Morrissey, J., *Maintenance Operations in Mission Oriented Protective Posture Level IV (MOPPIV) Part II*, U.S. Army Ballistic Research Laboratory, APG, MD, BRL-MR-3630, 1987.
7. Wick, C. and Morrissey, J., *Radio Teletype Operations in Mission Oriented Protective Posture*, U.S. Army Ballistic Research Laboratory, APG, MD, BRL-TR-3046, 1989.
8. Wick, C.; Morrissey, J. and Klopchic, J.T., *Maintenance Operations in Mission Oriented Protective Posture Level IV (MOPPIV)*, U.S. Army Ballistic Research Laboratory, APG, MD, BRL-MR-3629, 1987.
9. Wick, C.; Morrissey, J. and Klopchic, J.T., *Night Reconnaissance Operations in Mission Oriented Protective Posture*, U.S. Army Ballistic Research Laboratory, APG, MD, BRL-MR-3628, 1987.
10. Wick, C.; Wadsworth, H.; Holtzclaw, J.; Turner, J. and Cummings, J., *Evaluating the Interaction Between Training and Uniform When Operating in a Chemical Environment*, U.S. Army Ballistic Research Laboratory, APG, MD, In Preparation, BRL-TR-xxxx.
11. Wick, C.; Wadsworth, H.; Turner, J.; Dawson, D. and Frye, D., *Analysis of Radio-Teletype Messages Sent While Wearing Individual Protective Equipment*, U.S. Army Ballistic Research Laboratory, In Preparation, APG, MD, BRL-TR-xxxx.
12. Cox, T.J.; Jeffers, A.R. and Mascarella, T.J., *Ground Crew Chemical Defense Equipment Performance Task-Time Degradation Test*, ASD-TR-81-5003, 1981.
13. Dept. of AF, USAFTAWC, *Final Report, CWD Sortie Production and Employment Exercise*, 1985a.
14. Detoro, S.D.; et al. *Chemical Warfare Defense Ops: Field Study Methods and Results*, AFAMRL-TR-81-063 WPAFB, 1984.

15. Flowers, J.J. and Kovatch, D.H., *Combat Damage Repair Estimating Procedures Phase II-Development of Repair Time Estimator and Data Base*, ASD-TR-83-5011, 1984.
16. Flowers, J.J.; Kovatch, D.H. and Day, R.L., *Aircraft Combat Damage Repair Estimating Procedures, Phase I-Development of Required Estimator Format and Data Base Content*, ASD-TR-82-5018, 1982.
17. Lindeman, R.A., *Development and Tryout of Techniques to Measure Performance of Maintenance Personnel Wearing CWD Suits.*, (no date).
18. Mascarella, T.J., *Rapid Runway Repair Task Degradation Study*, ESL-TR-83-06, 1982.
19. Davis, E.G., *Overview of the U.S. Army Physiological And Psychological Effects Of The Nuclear, Biological, And Chemical Environment And Sustained Operations On Systems In Combat (P2NBC2) Database*, U.S. Army Ballistic Research Laboratory, APG, MD, In Preparation, BRL-TR-xxxx.
20. Wick, C.H., *Performance Estimates for Operations Conducted While Wearing Individual Protective Equipment: User Manual*, U.S. Army Ballistic Research Laboratory, APG, MD, BRL-MR- 3647, January 1988.
21. *Program Management Plan For The Assessment Of The Physiological And Psychological Effects Of The NBC Environment And Sustained Operations On Systems In Combat (P2NBC2)*, U.S. Army Chemical School, Fort McClellan, Alabama, 36205-5020, October 1989, (Version 2.2).
22. D. Cunningham, U.S. Army Chemical School, FT. McClellan, AL, private communication, 1989.
23. Klopac, J.T., and Roach, L.K., *An Introduction To The Use Of The Army Unit Resiliency Analysis (AURA) Methodology: Volume 1*, U.S. Army Ballistic Research Laboratory, APG, MD, BRL-MR-3384, September 1984.
24. Klopac, J.T., *Input Manual For The Army Unit Resiliency Analysis (AURA) Methodology: 1988 Update*, U.S. Army Ballistic Research Laboratory, APG, MD, BRL-TR-2914, May 1988.
25. R.M. Sheroke Jr., U.S. Army Ballistic Research Laboratory, APG, MD, private communication, 1990.
26. S.S. Juarascio, U.S. Army Ballistic Research Laboratory, APG, MD, private communication, 1989-1990.

APPENDIX A

LIST OF HUMAN ABILITY CODES AND HUMAN SUB-ABILITY CODES WITH DEFINITIONS

INTENTIONALLY LEFT BLANK.

LIST OF HUMAN ABILITY CODES AND HUMAN SUB-ABILITY CODES WITH DEFINITIONS

I. COMMUNICATION SKILLS (COM)

A01. SPEECH COMPREHENSION This is the ability to understand spoken English words and sentences.

A02. READING COMPREHENSION This is the ability to understand written sentences and paragraphs.

A03. SPEECH EXPRESSION This is the ability to use English words or sentences in speaking so others will understand.

A04. WRITTEN EXPRESSION This is the ability to use English words or sentences in writing so others will understand.

A05. AUDITORY ATTENTION This is the ability to focus on a single source of auditory information in the presence of other distracting and irrelevant auditory stimuli.

A06. SPEECH CLARITY This is the ability to communicate orally in a clear fashion that is understandable to a listener.

II. NUMERICAL DATA SKILLS (NUM)

A07. MEMORIZATION This is the ability to remember information, such as words, numbers, pictures, procedures. Pieces of information can be remembered by themselves or with other pieces of information.

A08. NUMBER FACILITY This ability involves the degree to which adding, subtracting, multiplying and dividing can be done quickly and correctly. These can be steps in other operations like finding percents and taking square roots.

III. DECISION MAKING SKILLS (DMS)

A09. PROBLEM SENSITIVITY This is the ability to tell when something is wrong or is likely to go wrong. It includes being able to identify the whole problem as well as the elements of the problem.

A10. DEDUCTIVE REASONING This is the ability to apply general rules to specific problems to come up with logical answers. It involves deciding if an answer makes sense.

A11. INDUCTIVE REASONING This is the ability to combine separate pieces of information, or specific answers to problems, to form general rules or conclusions. This involves the ability to think of possible reasons why things go together.

A12. INFORMATION ORDERING This is the ability to correctly follow a rule or set of rules to arrange things or actions in a certain order. The rule or set of rules to be used must already be given. The things or actions to be put in order can include numbers, letters, words, pictures, procedures, sentences, and mathematical or logical operations.

IV. PRECISION CONTROL SKILLS (PRE)

A13. MANUAL DEXTERITY This is the ability to make skillful, coordinated movements of one hand, a hand together with its arm, or two hands to grasp, place, move or assemble objects like hand tools or blocks. This ability involves the degree to which these arm-hand movements can be carried out quickly. It does not involve moving machine or equipment controls like levers.

A14. FINGER DEXTERITY This is the ability to make skillful, coordinated movements of the fingers of one or both hands and to grasp, place or move small objects. This ability involves the degree to which these finger movements can be carried out quickly.

A15. WRIST-FINGER SPEED This is the ability to make fast simple, repeated movements of the fingers, hands and wrists. It involves little, if any, accuracy or eye-hand coordination.

V. MOVEMENT AND COORDINATION (MOV)

A16. EXTENT FLEXIBILITY This is the ability to bend, stretch, twist or reach out with the body, arms or legs.

A17. DYNAMIC FLEXIBILITY This is the ability to bend, stretch, twist or reach out with the body, arms and/or legs both quickly and repeatedly.

A18. GROSS BODY COORDINATION This is the ability to coordinate the movement of the arms, legs and torso together in activities where the whole body is in motion.

A19. GROSS BODY EQUILIBRIUM This is the ability to keep or regain one's body balance, or to stay upright when in an unstable position. This ability includes being able to maintain one's balance when changing direction while moving or when standing motionless.

VI. ATTENTION AND QUICKNESS (ATT)

A20. REACTION TIME This is the ability to give one fast response to one signal (sound, light, picture, etc.) when it appears. This ability is concerned with the speed with which the movement can be started with the hand, foot, etc.

A21. SPEED OF LIMB MOVEMENT This ability involves the speed with which a single movement of the arms or legs can be made. This ability does not include accuracy, careful control or coordination of movement.

A22. SELECTIVE ATTENTION This is the ability to concentrate on a task one is doing and not be distracted. When distraction is present, it is not part of the task being done. This ability also involves concentrating while performing a boring task.

A23. DIVIDED ATTENTION This is the ability to shift back and forth between two or more sources of information.

VII. VISUAL PATTERN (VIN)

A24. SPEED OF CLOSURE This ability involves the degree to which different pieces of information can be combined and organized into one meaningful pattern quickly. It is not known beforehand what the pattern will be. The material may be visual or auditory.

A25. FLEXIBILITY OF CLOSURE This is the ability to identify or detect a known pattern (like a figure, word, object) which is hidden in other material. The task is to pick out the pattern for which you are looking for from the background material.

A26. SPATIAL ORIENTATION This is the ability to tell where you are in relation to the location of some object or to tell where the object is in relation to you.

A27. VISUALIZATION This is the ability to imagine how something will look when it is moved around or when its parts are moved or rearranged. It requires the forming of mental images of what patterns or objects for which you are looking for would look like after certain changes such as unfolding or rotation. One has to predict what an object, set of objects or pattern would look like after the changes were carried out.

A28. PERCEPTUAL SPEED This ability involves the degree to which one can compare letters, numbers, objects, pictures or patterns, both quickly and accurately. The things to be compared may be presented at the same time or one after the other. This ability also includes comparing a presented object with a remembered object.

VIII. MANUAL CONTROL SKILLS (MAN)

A29. CONTROL PRECISION This is the ability to move controls of a machine or vehicle. This involves the degree to which these controls can be quickly and repeatedly moved to exact positions.

A30. MULTILIMB COORDINATION This is the ability to coordinate movements of two or more limbs (for example, two arms, two legs or one leg and one arm) together, such as in moving equipment controls. Two or more limbs are in motion, while the individual is sitting, standing or lying down.

A31. RATE CONTROL This is the ability to adjust an equipment control in response to changes in the speed and/or direction of a continuously moving object or scene. The ability involves timing these adjustments and anticipating these changes. This ability does not extend to situations in which both the speed and direction of the object are perfectly predictable.

A32. ARM-HAND STEADINESS This is the ability to keep the hand and arm steady. It includes steadiness while making an arm movement as well as while holding the arm and hand in one position. This ability does not involve strength or speed.

IX. STRENGTH AND STAMINA (STR)

A33. STAMINA This is the ability of the lungs and circulatory (blood) systems of the body to perform efficiently over long time periods. This is the ability to exert oneself physically without getting out of breath.

A34. STATIC STRENGTH This is the ability to use muscle force in order to lift, push, pull or carry objects. It is the maximum force that one can exert for a brief period of time.

A35. EXPLOSIVE STRENGTH This is the ability to use short bursts of muscle force to propel oneself or an object. It requires gathering energy for bursts of muscle effort over a very short time period.

A36. DYNAMIC STRENGTH This is the ability of the muscles to exert force repeatedly or continuously over a long time period. This is the ability to support, hold up, or move the body's own weight and/or objects repeatedly over time. It represents muscular endurance and emphasizes the resistance of the muscles to fatigue.

A37. TRUNK STRENGTH This ability involves the degree to which one's stomach and lower back muscles can support part of the body repeatedly or continuously over time. The ability involves the degree to which these trunk muscles do not "give out," or fatigue, when they are put under such repeated or continuous strain.

X. VISION (VIS)

A38. NEAR VISION This is the capacity to see close environmental surroundings.

A39. FAR VISION This is the capacity to see distant environmental surroundings.

A40. VISUAL COLOR DISCRIMINATION This is the capacity to match or discriminate between colors. This capacity also includes detecting differences in color purity (saturation) and brightness (brilliance).

A41. NIGHT VISION This is the ability to see under low light conditions.

A42. PERIPHERAL VISION This is the ability to perceive objects or movement towards the edges of the visual field.

APPENDIX B

LIST OF ACTION VERB CODES

INTENTIONALLY LEFT BLANK.

LIST OF ACTION VERB CODES

1. ALIGN
2. APPROACH
3. ARM
4. ASSEMBLE
5. BEND
6. CHECK
7. CLEAN
8. CLEAR
9. CLOSE
10. COMMAND
11. CONNECT
12. COVER
13. DESTROY
14. DISASSEMBLE
15. DISCONNECT
16. EMLACE
17. ENERGIZE
18. ERECT
19. EVALUATE
20. FILL
21. FINISH
22. GROUND
23. INCREASE
24. INSERT
25. INSPECT
26. INSTALL
27. LAY
28. LEVEL
29. LIFT
30. LOAD
31. LOCK
32. MAKE
33. MARCHORDER
34. MILL
35. MOVE
36. OPEN
37. POSITION
38. POWER-UP
39. PREPARE
40. PRY
41. PULL
42. PUSH
43. RAISE
44. REFUEL
45. REMOVE

- 46. REMOVE&STOW
- 47. REPAIR
- 48. REPELL
- 49. REPLACE
- 50. REPORT
- 51. RETURN
- 52. ROTATE
- 53. SECURE
- 54. SEPARATE
- 55. SKETCH
- 56. SLIDE
- 57. SOLDER
- 58. STOW
- 59. SUPERVISE
- 60. SWEEP
- 61. TRANSFER
- 62. UNLOAD

APPENDIX C

**PERCENTAGE DISTRIBUTION FOR PERFORMANCE DECREMENT FACTOR (PDF)
ZONES A, B, AND C, FOR HUMAN ABILITY, HUMAN SUB-ABILITY, AND
ACTION VERB CODES**

INTENTIONALLY LEFT BLANK.

**PERCENTAGE DISTRIBUTION FOR PERFORMANCE DECREMENT FACTOR (PDF)
ZONES A, B, AND C, FOR HUMAN ABILITY, HUMAN SUB-ABILITY, AND
ACTION VERB CODES**

**TABLE C1. HUMAN ABILITY CODE PERCENTAGE DISTRIBUTION FOR
PERFORMANCE DECREMENT FACTOR (PDF) ZONES A, B, AND C**

HUMAN ABILITY CODE NAME	N	ZONE A	ZONE B	ZONE C
"UNL"	12	50%	50%	0%
ATT	27	4	96	0
COM	188	2	96	2
DMS	9	11	67	22
MAN	71	30	56	14
MOV	148	10	80	10
PRE	210	52	29	19
STR	3	0	100	0
VIN	87	3	91	6
VIS	1	0	100	0

- NOTE: 1. Total number of tasks (N) = 756.
2. Zone A contains 21% of total 756 tasks.
3. Zone B contains 69% of total 756 tasks.
4. Zone C contains 10% of total 756 tasks.
5. "UNL" code describes task not assigned a Human Ability Code by Database developers.
6. Refer to Appendix A for Human Ability Code definitions.

TABLE C2. HUMAN SUB-ABILITY CODE PERCENTAGE DISTRIBUTION FOR PERFORMANCE DECREMENT FACTOR (PDF) ZONES A, B, AND C

HUMAN SUB-ABILITY CODE NAME	N	ZONE A	ZONE B	ZONE C
"UNL"	118	6%	92%	2%
A01	2	0	100	0
A02	44	2	96	2
A03	22	0	100	0
A06	16	6	88	6
A09	2	0	100	0
A12	7	14	57	29
A13	99	60	25	15
A14	110	46	32	22
A16	69	4	87	9
A17	25	28	64	8
A18	42	12	86	2
A19	11	0	36	64
A20	8	0	100	0
A22	18	6	94	0
A24	22	5	95	0
A27	40	5	85	10
A28	24	0	96	4
A29	28	29	54	17
A30	37	27	70	3
A31	1	100	0	0
A32	7	29	29	42
A33	1	0	100	0
A36	2	0	100	0
A38	1	0	100	0

- NOTE: 1. Total number of tasks (N) = 756.
2. Zone A contains 21% of total 756 tasks.
3. Zone B contains 69% of total 756 tasks.
4. Zone C contains 10% of total 756 tasks.
5. "UNL" code describes task not assigned a Human Sub-Ability Code by Database developers.
6. Refer to Appendix A for Human Sub-Ability Code definitions.

TABLE C3. ACTION VERB CODE PERCENTAGE DISTRIBUTION FOR PERFORMANCE DECREMENT FACTOR (PDF) ZONES A, B, AND C.

ACTION VERB CODE NAME	N	ZONE A	ZONE B	ZONE C
"UNL"	7	71%	29%	0%
ALIGN	8	13	50	37
APPROACH	2	0	100	0
ARM	2	100	0	0
ASSEMBLE	17	12	88	0
BEND	1	0	0	100
CHECK	14	14	71	14
CLEAN	3	67	33	0
CLEAR	4	0	100	0
CLOSE	1	100	0	0
COMMAND	30	0	90	10
CONNECT	3	67	33	0
COVER	1	100	0	0
DESTROY	2	100	0	0
DISASSEMBLE	1	0	100	0
DISCONNECT	5	80	0	20
EMPLACE	14	29	71	0
ENERGIZE	3	33	67	0
ERECT	3	33	67	0
EVALUATE	3	33	33	33
FILL	4	0	0	100
FINISH	4	0	100	0
GROUND	4	25	50	25
INCREASE	1	100	0	0
INSERT	5	40	40	20
INSPECT	2	0	100	0
INSTALL	7	57	29	14
LAY	2	50	50	0
LEVEL	8	13	75	13
LIFT	1	100	0	0
LOAD	11	18	82	0
LOCK	1	0	0	100
MAKE	1	100	0	0
MARCHORDER	14	29	71	0
MILL	2	100	0	0
MOVE	11	9	64	27
OPEN	1	0	100	0
POSITION	2	0	50	50

ACTION VERB CODE NAME	N	ZONE A	ZONE B	ZONE C
POWER-UP	1	100	0	0
PREPARE	7	29	71	0
PRY	2	0	0	100
PULL	1	100	0	0
PUSH	1	100	0	0
RAISE	1	100	0	0
REFUEL	2	50	50	0
REMOVE	88	50	32	18
REMOVE&STOW	3	33	67	0
REPAIR	268	1	94	4
REPELL	3	0	0	100
REPLACE	75	49	31	20
REPORT	1	100	0	0
RETURN	1	100	0	0
ROTATE	2	50	50	0
SECURE	10	30	40	30
SEPARATE	1	100	0	0
SKETCH	2	50	0	50
SLIDE	2	50	50	0
SOLDER	2	100	0	0
STOW	7	0	100	0
SUPERVISE	63	0	100	0
SWEEP	2	0	100	0
TRANSFER	3	100	0	0
UNLOAD	3	33	67	0

- NOTE: 1. Total number of tasks (N) = 756.
2. Zone A contains 21% of total 756 tasks.
3. Zone B contains 69% of total 756 tasks.
4. Zone C contains 10% of total 756 tasks.
5. "UNL" code describes task not assigned an Action Verb Code by Database developers.

<u>No of Copies</u>	<u>Organization</u>
2	Administrator Defense Technical Info Center ATTN: DTIC-DDA Cameron Station Alexandria, VA 22304-6145
1	HQDA (SARD-TR) WASH DC 20310-0001
1	Commander US Army Materiel Command ATTN: AMCDRA-ST 5001 Eisenhower Avenue Alexandria, VA 22333-0001
1	Commander US Army Laboratory Command ATTN: AMSLC-DL Adelphi, MD 20783-1145
2	Commander US Army, ARDEC ATTN: SMCAR-IMI-I Picatinny Arsenal, NJ 07806-5000
2	Commander US Army, ARDEC ATTN: SMCAR-TDC Picatinny Arsenal, NJ 07806-5000
1	Director Benet Weapons Laboratory US Army, ARDEC ATTN: SMCAR-CCB-TL Watervliet, NY 12189-4050
1	Commander US Army Armament, Munitions and Chemical Command ATTN: SMCAR-ESP-L Rock Island, IL 61299-5000
1	Commander US Army Aviation Systems Command ATTN: AMSAV-DACL 4300 Goodfellow Blvd. St. Louis, MO 63120-1798

<u>No of Copies</u>	<u>Organization</u>
1	Director US Army Aviation Research and Technology Activity ATTN: SAVRT-R (Library) M/S 219-3 Ames Research Center Moffett Field, CA 94035-1000
1	Commander US Army Missile Command ATTN: AMSMI-RD-CS-R (DOC) Redstone Arsenal, AL 35898-5010
1	Commander US Army Tank-Automotive Command ATTN: AMSTA-TSL (Technical Library) Warren, MI 48397-5000
1	Director US Army TRADOC Analysis Command ATTN: ATRC-WSR White Sands Missile Range, NM 88002-5502
(Class. only) 1	Commandant US Army Infantry School ATTN: ATSH-CD (Security Mgr.) Fort Benning, GA 31905-5660
(Unclass. only) 1	Commandant US Army Infantry School ATTN: ATSH-CD-CSO-OR Fort Benning, GA 31905-5660
1	Air Force Armament Laboratory ATTN: AFATL/DLODL Eglin AFB, FL 32542-5000 <u>Aberdeen Proving Ground</u>
2	Dir, USAMSAA ATTN: AMXSY-D AMXSY-MP, H. Cohen
1	Cdr, USATECOM ATTN: AMSTE-TD
3	Cdr, CRDEC, AMCCOM ATTN: SMCCR-RSP-A SMCCR-MU SMCCR-MSI
1	Dir, VLAMO ATTN: AMSLC-VL-D

<u>No of</u> <u>Copies</u>	<u>Organization</u>	<u>No of</u> <u>Copies</u>	<u>Organization</u>
2	Director HQ, TRAC RPD ATTN: ATRC-N ATRC-T Fort Monroe, VA 23651	5	Commander Army Natick R&D Center ATTN: STRNC-A STRNC-I STRNC-U STRNC-YA STRNC-W Natick, MA 01760
1	HQ FORSCOM FCJ3-TN Fort McPherson, GA 30330-6000	1	Commander USAFKSWC ATTN: ATSU-CD-CS Fort Bragg, NC 28307-5000
1	Commander US Army Western Command ATTN: APO-NC APLG-MU Fort Shafter, HI 96858 Picatinny Arsenal, NJ 07801-5001	5	Commandant US Army Chemical School ATTN: ATZN-CM-FECD ATZN-CM-CS ATZN-CM-CT ATZN-CM-CC ATZN-CM-NF Fort McClellan, AL 36205
1	Commander CFA (ROK/US) ATTN: C3-NBC APO San Francisco, CA 96301	1	Commandant US Army Quartermaster School ATTN: ATSM-CDC Fort Lee, VA 23801-5037
1	Commander US Army Logistics Center ATTN: ATCL-MN Fort Lee, VA 23801	4	Commander US Army Nuclear and Chemical Agency ATTN: MONA-NU MONA-CM MONA-WE MONA-SAL 7500 Backlick Road, Bldg. 2073 Springfield, VA 22150
3	Commander US Army Laboratory Command Survivability Management Office ATTN: SLCSM-D SLCSM-C3I SLCSM-GS 2800 Powder Mill Road Adelphi, MD 20783-1145	3	Commander US Army TRADOC Analysis Center ATTN: ATRC-WDB ATRC-TSL White Sands Missile Range, NM 88002-5502
1	Commander US Army Transportation Center and Fort Eustis ATTN: ATSP-PD-C (Cheical Officer) Fort Eustis, VA 23604	2	Director US Army TRADOC Analysis Command ATTN: ATRC-FWW ATZL-TIE Fort Leavenworth, KS 66027-5200
1	Commander US Army Aviation Center ATTN: ATZQ-D-MS Fort Rucker, AL 36362	1	President US Army Armor & Engineer Board ATTN: ATZK-AE-TR Fort Knox, KY 40121-5470
1	Commander US Army Foreign Science Technology Center ATTN: AIAST-RA-ID2 Charlottesville, VA 22901		

No of Copies	Organization
1	Commanding General Wright-Patterson Air Force Base ATTN: AFAMRL-HE Wright-Patterson AFB, OH 45433-6553
2	WRCD/FIVS/SURVIAC Wright-Patterson AFB, OH 45433-6553
4	Commander US Army Dugway Proving Ground ATTN: STEDP-SD-TA-F STEDP-SD-TA STEDP-MT-CA-CB STEDP-MT-C Dugway, UT 84022
1	Commander, USACECOM R&D Technical Library ATTN: ASQNC-ELC-I-T, Myer Center Fort Monmouth, NJ 07703-5000
1	Office of the Secretary of Defense OATSD(AE) (Chemical Matters) Washington, DC 20301
1	Department of Defense OUSDRE(ELS) Room 3/D129, Pentagon Washington, DC 20301
1	Organization of Joint Chiefs of Staff ATTN: J-3 JOD (Col. Tripler) Washington, DC 20301
1	Director Armed Forces Medical Intelligence Center ATTN: AFMIC-ZA Fort Detrick, MD 21701
1	Commander in Chief US European Command ATTN: ECJ5-N APO, NY 09128
1	Commander in Chief Pacific ATTN: J5414, Box 15 Camp Smith, HI 96861
1	Commander in Chief US Atlantic Fleet ATTN: J338 Norfolk, VA 23511

No of Copies	Organization
1	Commander in Chief US Southern Command ATTN: SCJ3 APO Miami, FL 34004
1	Commander in Chief US Central Command ATTN: CCJ3-X MacDill AFB, FL 33608-7001
1	Commander in Chief US Special Operations Command ATTN: SOJ3-05 (Chemical Officer) MacDill AFB, FL 33608
1	Commander US Forces Japan ATTN: J3 APO San Francisco, CA 96301
1	Commander US Forces Korea ATTN: CJ-PL-N APO San Francisco, CA 96301
10	C.I.A. OIR/DB/Standard GE47 HQ Washington, DC 20505
3	Commander in Chief US Army Europe ATTN: AEAGC-NC-C APO, NY 09403
1	Director US Army Missile and Space Intelligence Center ATTN: AIAMS-YDL Redstone Arsenal, AL 35898-5500
2	Commandant US Marine Corps ATTN: POG-31 APW Room 2318, Arlington Annex Arlington, VA 20380
1	Battelle Edgewood Operations ATTN: F.T. Crimmins, Dir. CHIA 2113 Emmorton Park Road Edgewood, MD 21040

<u>No of</u> <u>Copies</u>	<u>Organization</u>
4	Director Defense Intelligence Agency ATTN: DT-5A DX-7B DB-4G1 DB-1B2 Washington, DC 20301
1	AFELM, The Rand Corporation ATTN: Library-D 1700 Main Street Santa Monica, CA 90406 <u>Aberdeen Proving Ground</u> Cdr, USATECOM AMSTE-SI-F AMSTE-TE-T Cdr, CRDEC, AMCCOM SMCCR-RSP SMCCR-TD SMCCR-TDT (Mr. Lawrence) SMCCR-ST SMCCR-PPD SMCCR-OPR SMCCR-NB Cdt, USAOC&S ATTN: ATSL-CDT ATSL-CD ATSL-CD-CS Dir, USAHEL ATTN: SLCHE-CC-LH

USER EVALUATION SHEET/CHANGE OF ADDRESS

This Laboratory undertakes a continuing effort to improve the quality of the reports it publishes. Your comments/answers to the items/questions below will aid us in our efforts.

1. BRL Report Number BRL-TR-3155 Date of Report DECEMBER 1990
2. Date Report Received _____
3. Does this report satisfy a need? (Comment on purpose, related project, or other area of interest for which the report will be used.) _____

4. Specifically, how is the report being used? (Information source, design data, procedure, source of ideas, etc.) _____

5. Has the information in this report led to any quantitative savings as far as man-hours or dollars saved, operating costs avoided, or efficiencies achieved, etc? If so, please elaborate. _____

6. General Comments. What do you think should be changed to improve future reports? (Indicate changes to organization, technical content, format, etc.) _____

CURRENT ADDRESS

Name

Organization

Address

City, State, Zip Code

7. If indicating a Change of Address or Address Correction, please provide the New or Correct Address in Block 6 above and the Old or Incorrect address below.

OLD ADDRESS

Name

Organization

Address

City, State, Zip Code

(Remove this sheet, fold as indicated, staple or tape closed, and mail.)

-----FOLD HERE-----

DEPARTMENT OF THE ARMY

Director
U.S. Army Ballistic Research Laboratory
ATTN: SLCBR-DD-T
Aberdeen Proving Ground, MD 21015-5066
OFFICIAL BUSINESS



NO POSTAGE
NECESSARY
IF MAILED
IN THE
UNITED STATES

BUSINESS REPLY MAIL
FIRST CLASS PERMIT No 0001, APG, MD

POSTAGE WILL BE PAID BY ADDRESSEE

Director
U.S. Army Ballistic Research Laboratory
ATTN: SLCBR-DD-T
Aberdeen Proving Ground, MD 21005-9989

-----FOLD HERE-----